Performance & Cost Targets for sCO2 Heat Exchangers (Recuperators)

October 15, 2015
Michael McDowell
Program Manager for sCO2 Technology

The Rocketdyne energy team is now part of the Gas Technology Institute (GTI)
Development of Systems Level Understanding of the Recuperator

> 2007 MIT sCO2 meeting
  - Identified small channel heat exchanger risk for plugging in Sodium systems
  - Now a test project at ANL

> 2011 Boulder sCO2 Power Cycle Symposium
  - Described the large cost impact of the recuperators & concern with the large number of small recuperators required in a commercial power plant as part of 1000 MWe plant concept design & cost study

> 2014 Performed evaluation of recuperator design, cost & development issues
  - Two vendors provided input
  - One with large units, one with small units
sCO2 Power Plant Modeling Defines Recuperator Needs

Indirect Cycle
• Heat exchanger provides sCO2 to turbine
• Near term deployment
• Recently increased pressure to 4000psi to reduce equipment size & increase efficiency

Direct Cycle
• High pressure combustion gasses go directly into turbine
• Higher temperature, higher efficiency, slower deployment
Recuperator Study Accomplishments

- Showed that the recuperator indirect cycle performance requirements can be met
  - Commercial scale sCO₂ power plant (550 MWe)
  - Defined a maturation roadmap
- Contracted with two heat exchanger vendors
  - One conventional (advanced shell and tube)
  - One advanced compact heat exchanger
- Prepared development plan & commercial system cost estimate
Recuperator Study Result: Dependence of Cost on System Criteria

- Lower recuperator cost with higher approach temperature
  - Less energy recuperated
  - Lower plant efficiency
  - Possible higher LCOE

- Lower recuperator cost by allowing higher pressure loss
  - Lower plant efficiency
  - Possible higher LCOE

Additionally: Almost a 4:1 difference in cost between two vendor concepts for the same criteria
Conclusion

> Recuperators are a large part of plant capital cost
  ─ Costs vary widely between vendors

> Adjusting criteria to reduce recuperator cost could increase plant LCOE

> Need Integrated system performance & cost model
  ─ Optimize component/recuperator criteria
  ─ Involve vendors for recuperator cost data
  ─ Consider physical integration issues
  ─ Optimize plant LCOE

> Model results needed to set cost & performance targets
Turning Raw Technology into Practical Solutions

michael.mcdowell@gastechnology.org

www.gastechnology.org | @gastechnology